

REMARKS

The applicants thank the examiner for withdrawal of the restriction requirement.

The examiner objected to the specification because the cross reference contained a typographical error. The applicants respectfully request entry of the amendment to correct the application number to read PCT/US2004/025050 in both instances.

The examiner rejected claim 6 under 35 U.S.C. §102(b) over US2002/0153618 to Hirano, *et al.* (Hirano). Claim 6 has been canceled, therefore, the applicants request that the rejection under 35 U.S.C. §102(b) be withdrawn and the claims allowed to issue.

The examiner rejected claims 7-16 under 35 U.S.C. §103(a) over Hirano in view of U.S. Patent 3,808,673 to Bottini (Bottini) because the examiner argues that Hirano discloses the parts of the semiconductor device prepared by the method of claims 7-16. However, the examiner admits that Hirano does not disclose the specific details regarding the injection molding process, including clamping force, injection pressure, heating, curing conditions, plasma treating, and contacting plasma treated surfaces with each other. The examiner further argues that Bottini discloses that a semiconductor device can be packaged by injection molding a silicone resin by curing for 120 to 150 seconds at a mold temperature of 190 °C, a pressure of 600 psig (about 4 MPa), and a clamping force of 15 tons. The examiner concludes that it would have been obvious for a person of ordinary skill in the art to combine the teachings of Hirano and Bottini in order to use the injection molding parameters of Bottini for sealing the package of Hirano because Bottini shows these are known parameters for injection molding a silicone resin.

Hirano discloses a semiconductor device having a semiconductor chip mounted on a first surface (chip mounting surface) of a substrate. An electrode is formed on a circuit forming surface of the semiconductor chip, and a wire electrically connects the electrode with an interconnection to

pads on the substrate (Abstract). Hirano discloses that wire sagging is a problem with the face up chip scale type packages described therein, and wire sagging after bonding can cause short circuit between the wire and interconnection (paragraph [0006]). Hirano discloses that in a step for sealing the semiconductor chip and wire with a resin by transfer molding, wire flow tends to be caused by the insulating resin injected under pressure, leading to inconveniences such as short circuit between adjacent wires (paragraph [0007]).

Bottini discloses a multiple step process in which dice are wire bonded to lead frames. After wire bonding, a semiconductor junction coating resin, such as a clear silicone resin, is applied between the emitter and detector devices (col. 3, line 53 to col. 4, line 12 and figures 2A, 2b, 2a, and 3b). The emitter lead frame is brought into contact with the detector lead frame, thus encapsulating and coupling the LED and silicon photo-diode in the clear silicone resin. The coupled lead frames are placed in an oven and heated to about 150 °C for two hours to cure the resin (col. 4, lines 12-17 and figure 4). Figure 4 shows a sectional view of the emitter-detector coupled pair after encapsulation in the clear resin. The wire bonded LED 16 is coupled optically and mechanically by the cured clear silicone resin to the wire bonded silicon photodetector (col. 4, lines 17-24 and Figure 5). The next step in the fabrication process involves the encapsulation of the emitter-detector pair with an opaque plastic material (col. 4, lines 25-27). The process conditions described by the examiner (temperature, cycle time, transfer pressure, and clamping pressure), which are described at col. 4, lines 30-39 are for a transfer molding process.

This invention pertains to a method comprising:

- i) placing a semiconductor device in an open mold,
- ii) closing the mold to form a mold cavity,
- iii) heating the mold cavity,
- iv) injection molding a curable liquid comprising a silicone composition into the mold cavity to overmold the semiconductor device,

v) opening the mold and removing the product of step iv), and optionally vi) post-curing the product of step v). The silicone composition has a viscosity of 80 to 3000 Poise, and a cured product of the silicone composition has a modulus of 100 to 1,000 megaPascals.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure MPEP §2143. Even where the combination of the references taught every element of the claimed invention, however without a motivation to combine, a rejection based on a *prima facie* case of obvious was held improper MPEP §2143.01. The level of skill in the art cannot be relied upon to provide the suggestion to combine references MPEP §2143.01. The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination MPEP §2143.01. The claimed combination (of references) cannot change the principle of operation of the primary reference or render the reference inoperable for its intended purpose MPEP §2145 (III).

The prior art can be modified or combined to reject claims as *prima facie* obvious as long as there is a reasonable expectation of success MPEP §2143.02. At least some degree of predictability is required MPEP §2143.02. Evidence showing there was no reasonable expectation of success may support a conclusion of nonobviousness MPEP §2143.02. Whether an art is predictable or whether the proposed modification or combination of the prior art has a

reasonable expectation of success is determined at the time the invention was made MPEP §2143.02.

Hirano discloses that wire sagging and wire flow are known problems in fabricating semiconductor devices. There is no motivation to remove required steps from the method of Bottini (*i.e.*, application of clear silicone composition and cure of the composition to form a junction coating resin) and use this modified method to prepare a device of Hirano because one skilled in the art would have expected removing the steps to apply and cure the junction coating resin would reduce protection for the wires and thereby aggravate the problems of wire sagging and/or wire flow. Therefore, one skilled in the art would have no reasonable expectation of success to combine and modify the disclosures of Hirano and Bottini with a reasonable expectation of success to arrive at the present invention and the first and second criteria for establishing a *prima facie* case of obviousness have not been met.

To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art MPEP §2143.03. All words in a claim must be considered in judging the patentability of that claim against the prior art MPEP §2143.03. If an independent claim is nonobvious under 35 U.S.C. §103, then any claim depending therefrom is nonobvious MPEP §2143.03.

Neither Bottini nor Hirano discloses all of the limitations of this invention. In this invention, the silicone composition used in the method has a viscosity of 80 to 3000 Poise, and a cured product of the silicone composition has a modulus of 100 to 1,000 megaPascals. The viscosity of the silicone composition and the modulus of its cured product provide the benefit of minimizing wire sweep (paragraphs [0031], [0033]). “Wire sweep” is movement of wires out of the designed shape, *e.g.*, arc. If wire sweep is too extreme, it can result in either wire breakage or wire contact, or both. Either of these will result in a defective electronic device (paragraph [010]).

Hirano discloses that movement of wires out of the designed shape is problematic. However, neither Hirano nor Bottini discloses the method for minimizing wire sweep described in this invention. Neither Hirano nor Bottini discloses these limitations for any purpose. Neither Hirano nor Bottini discloses any properties of an encapsulant that can provide the benefit of minimizing wire sweep. Therefore, the third criterion for establishing a *prima facie* case of obviousness has not been met, and the applicants respectfully request withdrawal of the rejection of claims 7-16 under 35 U.S.C. §103(a).

The examiner rejected claims 1 and 4 under 35 U.S.C. §103(a) over Hirano in view of Bottini and further in view of US2003/145940 to Chaudhury, *et al.* (Chaudhury) for the same reasons discussed above for claims 7-16 and because the examiner further argues that Chaudhury discloses that surfaces of an adhesive and a semiconductor can be plasma treated to improve adhesion between surfaces. The examiner further concludes that it would have been obvious to combine the disclosures of Hirano, Bottini, and Chaudhury to plasma treat the adhesive surface and chip surface for improved adherence.

The disclosures of Hirano and Bottini suffer from the same defects described above for claims 7-16. Chaudhury's disclosure of plasma treatment does not cure these defects. Furthermore, in the process of Bottini, the wires are encapsulated in the clear silicone resin BEFORE the transfer molding process to encapsulate the emitter-detector pair with the black plastic molding material. The wires are protected by the clear silicone resin and are not exposed to the process conditions of mold temperature 190 °C at cycle time 2 to 2.5 minutes under transfer pressure of 600 psig and clamp pressure of 15 tons. Claim 1 has been amended to reflect that there is no intermediate resin coating step as disclosed by Bottini, and support for this amendment may be found at paragraphs [0011], [0015], and [0016]. Claim 4 is dependent on claim 1 and includes all of the limitations thereof. Therefore, the objection of claims 1 and 4 under 35 U.S.C. §103(a) over

Hirano in view of Bottini and further in view of Chaudhury is moot, and the applicants respectfully request withdrawal of the rejection.

The examiner rejected claim 2 under 35 U.S.C. §103(a) over Hirano in view of Bottini and further in view of Chaudhury and U.S. Patent 6,475,629 to Takeuchi, *et al.* (Takeuchi). The examiner argued that the combination of Hirano, Bottini, and Chaudhury has all of the limitations of claim 1 for the reasons described above. The examiner admits that this combination does not teach or suggest that the die attach adhesive includes silicone. The examiner further argues that Takeuchi discloses that a die attach adhesive can include a siloxane-based resin. The examiner concludes it would have been obvious to combine Hirano, Bottini, Chaudhury, and Takeuchi to include silicone material in the die attach adhesive because Takeuchi discloses that siloxane resin exhibits strong adhesion.

The defects of Hirano in view of Bottini and Chaudhury are discussed above. A description of a siloxane resin of Takeuchi does not cure these defects. Claim 2 is dependent on claim 1 and includes all of the limitations thereof. Therefore, claim 2 is not obvious over Hirano in view of Bottini and further in view of Chaudhury and Takeuchi for the same reasons discussed above. For these reasons, the applicants request withdrawal of the rejection of claim 2 and allowance of all claims.

You are authorized to charge deposit account 04-1520 for any fees necessary to maintain the pendency of this application. You are authorized to make any additional copies of this sheet needed to accomplish the purposes provided for herein and to charge any fee for such copies to deposit account 04-1520.

Respectfully Submitted,
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